CO2 CAPTURE BY ABSORPTION INTO AQUEOUS TERTIARY AMINE SOLUTION

Carlos Cebamanos[1], Jian Chen[2] ,Carmen Clemente-Jul[1]

[1]*Chemical Engineering and Fuels Department, ETS Ingenieros de Minas, Technical University of Madrid (UPM), Spain*
[2]*Chemical Engineering Department, Tsinghua University* of Beijing, China

1.ABSTRACT

The aim of this research is to obtain the absorption rate of CO2 into aqueous solution of N,N- di methyl ethanolamine and into aqueous solution of Triethylene diamine and to demonstrate the importance of absorption of CO_2 in nowadays by discussing global warming and greenhouse effect.
It is also discussed the current situation of China focusing in the latest steps this country has recently made. In the experimental part of this work, the two tertiary amine solutions will absorb CO2 in a Lewis type cell, measuring the pressure change during the reactions take place. The temperature will be between 35 degree and 70 degree Celsius. The results of both solutions, concentrations of 0.5 and 1.0 mol per liter, are discussed and a single value of the rate constant is given for the first time along with some others parameters.

2. INTRODUCTION

The principal technical means of reducing fossil fuel consumption and thus emissions in these ever growing sectors, and other sectors, are: improve energy efficiency, replace fossil fuel with renewable energy types (biomass, wind, solar, hydro, etc.),replace fossil fuel with nuclear power and Switch to less carbon intensive fossils fuels, in particular from coal to gas. These measures also apply to other sectors as well. In the case of the electric power sector, improving the energy efficiency of electrical appliances is an important way to reduce CO_2 from power generation. This is a sector where the EU needs to improve to achieve the 2020 goal of a 20% increase in energy efficiency. Alternatively it is argued, citing the effect of fuel price increases on demand that one of the more efficient ways of cutting fossil fuel demand is to align the consumption tax system with greenhouse gas emissions, or more general environmental impact. In addition, when local conditions allow, CO_2 Capture and Storage (CCS) could be applied to reduce the carbon intensity of emissions from large scale fossil fuel combustion. Given that each of these options has different advantages and disadvantages for local communities, economic activities and environmental impacts, arriving at the appropriate mix and enabling policies for a country will depend on national and local circumstances, public and political preferences as well as the interest of businesses promoting the various options (MacDowell et al., 2010).

Although the contribution of the Kyoto targets to global greenhouse gas emission mitigation is rather limited, as was already known at that time, it is clear that the climate and energy policies introduced after the protocol was agreed, have served to stimulate and enhance many of the new economical and technological developments in the area of so-called ‘green technologies’, which would otherwise not have been penetrated so fast on the market. The CDM projects in developing countries, although often criticized for their additional effect, have triggered worldwide project activities in various sectors of society focussing on reduction of greenhouse gas emissions. As it has been seen, at present, the post-combustion process is more suitable for CO2 capture for the traditional pulverized coal plants in China. The main advantages and disadvantages of the CO_2 capture technologies for post-combustion were been also briefly reviewed. Among a range of separation technologies, absorption with solids including grafted ionic liquids, alkali earth metal oxide, amine modified sorbents, and K-based sorbents appears to be the most promising CO_2 capture strategies (Li et al., 2011).

However, if the absorption is to be used for large-scale implementation of CCS, the physical and chemical properties of the sorbent must be well understood with the combination of experimental and theoretical approaches, which enable the development of CO_2 selective sorbents (Maroto-Valer et al., 2005). Besides, the sorbent performance, lifetime, cost and the equipment for CO_2 capture must also be considered for practical application. On the one hand, the CO_2 capture technologies are being developed and it also requires new power plants have a larger scale in China (Deng et al., 2009). On the other hand, the need for higher efficiency, lower generation costs and emissions would also open opportunities for some application of supercritical (SC) and ultrasupercritical (USC) coal fired power plant technology in future (Zhang et al. ,2011). By the time, the pre-combustion, oxyfuel combustion, poly generation system for CO_2 capture, and other technologies might be viable in new power plant.

3. EXPERIMENTAL

The kinetics of CO2 absorption by aqueous solutions of N,N-dimethylethanolamine (DMEA) and Triethylene diamine (TEDA) were measured in the temperature range (308-343). A thermo regulated constant interfacial area Lewis-type cell was operated by recording the pressure drop during batch absorption.

The amine has absorbed the CO_2 in a wetted wall column where a film of liquid cascades down the inside surface of a tube, simulating the action of a cooling tower or absorption column, measuring the flow changes before and after the absorption with three flow meters and collecting the data in a computer.

The reactor is a Lewis cell which is composed of a quartz cylinder and two stainless steel flanges. The sealing is made by polymeric joins. The different parts of the Lewis cell are the following shown in the figure 1: (AB) air bath, (B) baffles, (MP) microcomputer, (MR) magnetic rod, (MS) magnetic stirrer, (P) propeller, (PP) platinum probe, (PT) pressure transducer, (RLI) temperature control liquid inlet, (RLO) thermostaticliquid outlet, (RT) Rushton turbine, (TED) thermal electronic display, (TDE) transparent thermostated double envelope, (TJ) thermostated jacket, (Vi) shut-off valve i, (VP) vacuum pump.

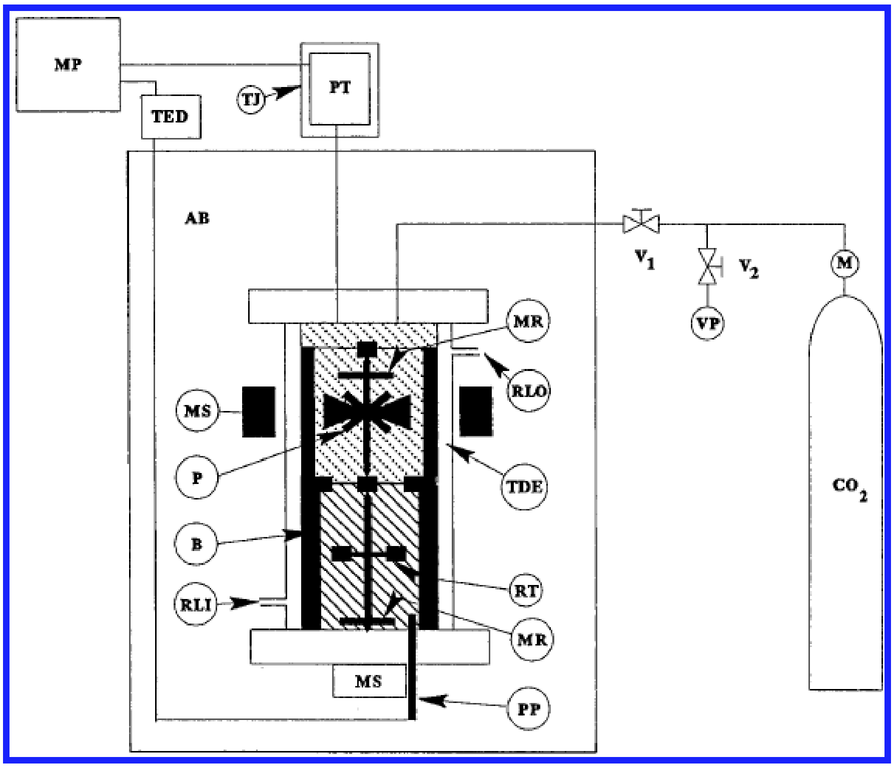

Fig.1. Lewis-type stirred reactor and its flow diagram

4. RESULTS AND DISCUSSION

From the experimental part of the project, the absorption rate of CO_2 into aqueous solution of N,N-dimethylethanolamine and into aqueous solution of Triethylene diamine has been measured successfully. The relative low price of these two amines made them an interesting possibility; however both of them do not have a high absorption rate as other amines do. The results obtained with N,N-dimethylethanolamine are shown in figure 2 as variation of ln (k) versus 1/T.

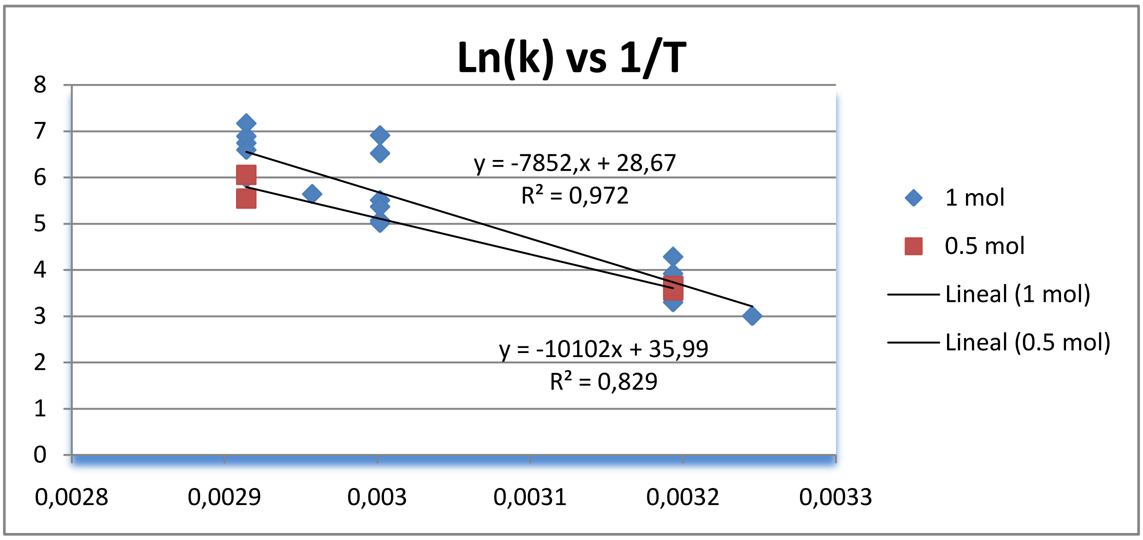

Fig.2. Variation of ln (k) versus 1/T with N,N-dimethylethanolamine.

The results obtained with Triethylene diamine are shown in figure 3.as variation of ln (k) versus 1/T.

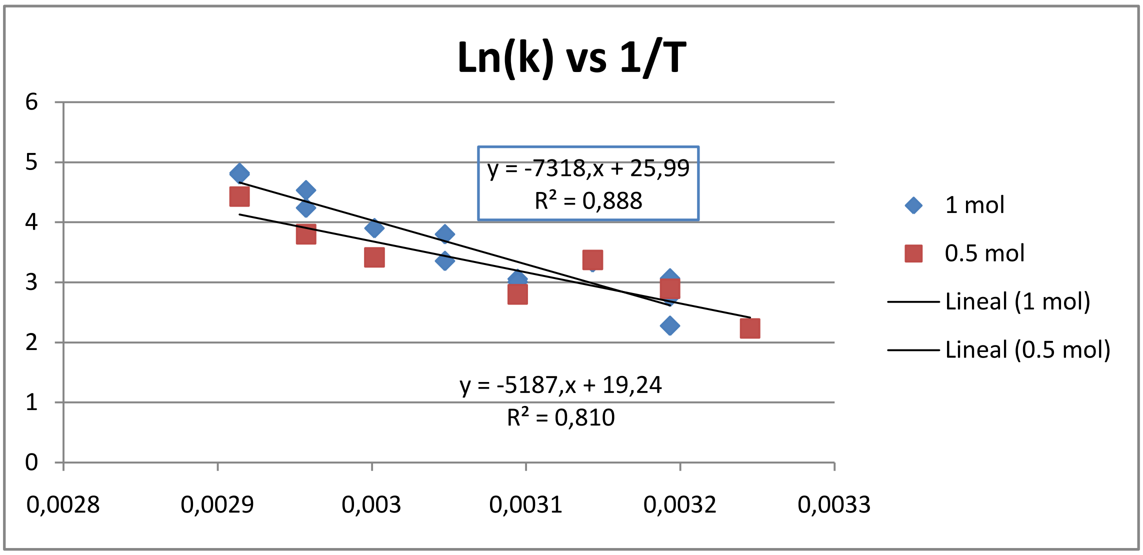

Fig.3. Variation of ln (k) versus 1/T with Triethylene diamine.

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